Int J Life Cycle Assess (2013) 18:529–534
DOI 10.1007/s11367-012-0530-8

CONFERENCE REPORT

49th Discussion forum on LCA—sustainable consumption patterns—September 18, 2012, Zurich, Switzerland

Karin Flury · Niels Jungbluth

Received: 8 October 2012 / Accepted: 7 November 2012 / Published online: 16 November 2012

Abstract There are different ways and strategies to reduce the environmental impacts caused today. One starting point for reducing the environmental impacts of today is the private consumption. Finally, all goods and services provided in a country contribute to fulfil the needs and demands of consumers. Several national and international initiatives therefore aim for a considerable reduction of the environmental impacts of consumption patterns. The 49th LCA Discussion Forum analysed the present consumption patterns of households and their consequent environmental impacts. Based on this, potentials for a reduction of the environmental impacts were identified and discussed. In this context, the possible applications, advantages and drawbacks of the life cycle assessment (LCA) methodology were analysed. National and international speakers provided qualified insights on the topic. The 49th Discussion Forum concentrated on different aspects of sustainable consumption patterns. The focus lay on private households and the environmental impacts caused by their consumption patterns. In the first session, the idea of the "2000-Watt society" was introduced as an example of a concept of a "sustainable lifestyle". Another way of analysing the total impacts is the consumption perspective introduced in a second presentation. Based on an analysis of environmental impacts due to final demand of Swiss households, different measures for a reduction of environmental impacts were proposed and analysed. The second session examined similar activities in Germany. The short presentations covered the communication of LCA results. The third session focused on web-based eco-calculators. In the last session, two scientific inputs were given on the modelling of household consumption patterns and on the impact of rebound effects on the environmental impact of private consumption. The most important consumption domains are nutrition, mobility and energy use in households. Apart from different modelling approaches and boundary conditions, the majority of the presentations showed that today's consumption patterns in Switzerland and Germany are far away from a sustainable level. Considerable reduction measures are needed in order to reach this goal. Eco-calculators and similar tools provide an effective way to raise customer awareness. In general, it is very important to communicate LCA results in a simple, clear and transparent way.

Keywords "2000-Watt Society" · Eco-calculator · Footprint · Lifestyles · Sustainable consumption

1 Introduction

The traditional approaches and strategies to reduce the environmental impacts caused today focus on industry and cleaner production patterns. Life cycle assessment can be used in order to analyse, compare and improve processes and services supplied to other industries and consumers. The second strategy focuses on the consumption patterns and thus the demand side. Life cycle assessment (LCA) can be used to analyse these patterns and to propose behavioural changes that could lead to lower environmental impacts. Private consumption patterns are however very complex and dependant on many different factors such as individual preferences. Several national and international initiatives have been implemented to analyse private consumption and promote sustainable lifestyle.

In the 49th LCA Discussion Forum in Switzerland, different studies and activities on the environmental impacts caused by private consumption lifestyle were presented and possible reduction potentials for sustainable lifestyles were discussed. The focus was on how LCA can contribute to this strategy and how the LCA methodology can be combined with other methodologies in order to further develop the idea of sustainable lifestyles.

K. Flury (✉) · N. Jungbluth
ESU-services Ltd., Margrit Rainer-Strasse 11c,
8050 Zurich, Switzerland
e-mail: flury@esu-services.ch

2 Situation in Switzerland

The private consumption patterns in Switzerland were in the focus of the first session. Starting from the introduction of the "2000-Watt society" concept as an objective for a sustainable lifestyle in Switzerland, the session moved on to a detailed analysis of today's private consumption and its environmental impacts. The identification of reduction potentials to reach a sustainable consumption level closed the circle.

Urs Vogel (Amstein+Walthert AG, Zurich) presented how the "2000-Watt Society" started as an idea and became a concept used in today's energy policy. The target value of 2,000 Watt (Joules per second) is derived from an early publication of Palmedo et al. (1978) where the quality of life index is compared to the energy consumption per capita: Kesselring and Winter (1994) argue that from an primary energy consumption level of 17,500 kWh per person and year, a further increase of the energy consumed no longer leads to a higher quality of life. Lower energy consumption levels however implicate a decrease in life quality. The 17,500 kWh per year correspond to a continuous requirement of 2,000 W, which gives the name for the concept. In 2002, the Swiss Federal Council declared the "2000-Watt Society" as long-term strategic goal for sustainable development. Since then, a steadily growing number of Swiss cantons, regions and cities are following this route.

The strategy of the "2000-Watt Society" foresees a reduction in the consumption rate of primary energy from 6,300 W per capita in 2005 to 3,500 W in 2050 and to the targeted 2,000 W in the year 2100. At the same time, the greenhouse gas emissions shall be cut from 8.6 t per capita to 2 t in 2050 and 1 t in the year 2100, respectively. The calculation of these figures is based on the direct end-energy demand in Switzerland (electricity and fuels). These figures are multiplied by the primary energy demands for providing these energy carriers in a life cycle perspective (so called "grey energy"). The calculation does not include emissions and energy uses due to the import of goods and services. Non-energy greenhouse gas emissions such as methane from cows or CO_2 from cement production as well as trade of goods and services are not balanced. The comparison of the Energy Perspectives 2050 developed by the Swiss Federal Council (Bundesamt für Energie 2012) to the reduction path of the "2000-Watt Society" shows a good compliance.

Niels Jungbluth (ESU services) investigated the environmental impacts of consumption patterns and the reduction potentials in Switzerland (Jungbluth et al. 2012). The starting point for this analysis is the final consumption by Swiss households and the public demand of energy, goods and services. The study evaluated not only the greenhouse gas emissions and the energy use but a broad range of environmental impacts applying the Swiss Ecological Scarcity Method 2006 (Frischknecht et al. 2009). A top-down approach (environmentally extended input–output-analysis (EE-IOA)) is applied to model the private consumption. At first, the environmental impacts of total consumption in Switzerland (including imports and exports) are determined (Jungbluth et al. 2011). The results are higher (20 million eco-points, 8,250 W, 12.8 t CO_2-eq) then the calculation according to the 2000-Watt methodology because also non-energy emissions and trade are taken into account. In a second step, the shares of the different consumption areas (e.g. nutrition, mobility, health and public services) are calculated with the EE-IOA. Within each area, further subcategories (e.g. meat and fish, beverages, vegetables, etc.) are established and their environmental impacts are determined by an LCA approach. Based on these results, reduction paths are identified and their potentials are estimated.

The three areas nutrition, energy use and mobility are the consumption areas with the highest environmental impacts. They cover 60 % of the total impacts of private consumption. The animal products (meat, fish, milk and eggs) cause nearly half of the impacts of the area nutrition. The impacts of the household energy use are dominated by the electricity and heating oil consumption. Private car driving causes the major share of environmental impacts in the area of private mobility.

A vegetarian diet, the change from the private car to public transport and the purchase of certified electricity are single measures with the highest reduction potentials in each area. The combination of different measures could lead to a reduction in the environmental impacts of the private consumption by 49 %. Around 22 % can be achieved in the area of nutrition, 12 % within private mobility and the impacts of the electricity use can be reduced by 15 %. Even if such considerable reductions of the environmental impacts are feasible, they can only be achieved by substantial changes in personal lifestyles.

3 Research work in Germany

In the second part, approaches and examples for sustainable lifestyles and consumers' decision support in Germany are shown.

Karl-Heinz Simon (Center for Environmental Systems Research, University of Kassel) presented a study on the Carbon Footprint of German eco-communities.[1] It was examined if any of these alternative modes of living fulfil the criteria of sustainability. The material and energy fluxes in the demand sectors food, mobility and dwelling are analysed for a commune, two eco-villages

[1] http://www.usf.uni-kassel.de/cesr/index.php?option=com_project&task=view_detail&agid=26&lang=en

and three reference small-family households. The data are gained by data collection campaigns in the different households examined. The analysis of the greenhouse gas emissions shows that all lifestyles under study lie considerably below the German average, whereas the two alternative lifestyles of the commune and the eco-villages show the lowest emissions. The study identified several sustainability-supporting components in communes and eco-villages: The households are often larger which leads to less living area per person. The households exhibit energy-efficient heating and warm water systems. The individual mobility is on average reduced and the share of vehicles driven by bioenergy is above average. Furthermore, vegetarian or even vegan is the preferred diet. In general, the cooperation among the inhabitants is better. All members work side-by-side towards similar ideals, all have the same interests and more manpower is available for common projects. The alternative communities are successful in reducing energy and material flows. However, despite considerable efforts, even actions more radical have to be implemented in order to reach a sustainable lifestyle level.

Rainer Griesshammer (Öko-Insitut e.V, Freiburg) focused on the project "Top 100". It concentrates on the 100 most important energy-relevant product groups for households and develops award criteria for the German eco-label "Blue Angel".[2] A greenhouse gas reduction potential of up to 40 % due to reduced electricity consumption is identified if existing, energy efficient products are bought and old products are replaced. Additional moderate changes in the behaviour can raise the reduction potential to 50 %. There are many factors that stimulate a decrease in electricity consumption: a decrease in the specific energy consumption of household appliances, the trend to device integration and smaller devices as well as the substitution due to technical alternatives. On the other hand, the number of households is increasing, larger devices are bought, the number of small devices with high energy consumption is increasing and new appliances are developed that will not substitute other devices. It is estimated that around one third of the power consumption can be reduced within relatively short time and with low costs (e.g. energy saving lamps, shower head aerator, etc.). Another third can be saved over a longer period by the substitution of appliances.

A range of product policies are proposed by the Öko-Institute to promote household energy savings. The measures range from strengthening the ecodesign directive to the implementation of ambitious energy efficiency regulations and the declaration of electricity costs in the use phase of appliances. Furthermore, a better support and consulting for the consumers should be provided.

[2] http://www.blauer-engel.de/

4 Web-based eco-calculators for consumers

Different eco-calculators have been developed in Switzerland, Germany and other countries that can analyse the environmental footprint of individual, regional and national consumption patterns. In the third session, such tools were introduced and discussed.

Fabian Scherer (Ecospeed AG, Zurich) presented different tools that are developed and run by Ecospeed. The tools mainly vary in scope of view and range from a process level to a global level.

Generally, three different types of tools can be distinguished among the existing eco-calculators. The first group of tools is intended for awareness-raising and education. They include all major areas of consumption and activities and focus mainly on energy use and greenhouse gas emissions. They are meant for a broad audience. Other tools are used for decision support and specific applications. Their focus lies on more specific areas of consumption or activities and on more specific environmental impacts. The third group contains the monitoring and measurement tools, which focus on the monitoring of certain parameters only. Direct measurements and integration in systems can be part of the tool.

The ECOPrivate tool developed by Eco-speed belongs to the first group. It is a tool to calculate a personal carbon footprint and primary energy demand. The four activity categories heating, appliances, mobility, nutrition and consumption are assessed. The users can entry key figures for their activity. These user-specific data can be compared with average data and reduction options are proposed in the end. An input–output approach was applied and connected to LCA data to determine the environmental impacts of the different activities. The user options are based on statistical data. The average energy consumption rate is calculated to be 6,300 W per person. These values are based on statistics of the years 1995–1998. Current energy consumption rates are considerably higher. Nevertheless, the ECOPrivate tool illustrates that drastic measures are needed to reach a consumption rate of 2,000 W per person.

René Itten (ESU services) introduced the updating project for the WWF ecological footprint calculator.[3] It covers the private consumption sectors nutrition, mobility, housing and energy as well as miscellaneous consumption. The environmental impacts per consumption area are calculated based on the Swiss EE-IOA. The answer to each question is rated and scaled according to the deviation of its impacts to the Swiss average impact. This calculation is based on LCA data. Environmental impacts are assessed with the Ecological Scarcity Method 2006 (Frischknecht et al. 2009).

[3] www.footprint.ch (new data are not yet online)

The ecological footprint is an indicator comparing the environmental impacts (e.g. resource depletion) caused by an activity to the planet's ecological capacity to regenerate. The indicator's unit is 'planets' indicating to what extend this capacity is exhausted. One or less planets imply that the activity under study does not exploit the capacities of our earth. A value above 1 indicates that the regeneration capacity is exhausted. The indicator can be calculated for one person or a certain region. Today, the global average footprint is 1.5 planets, which means that average consumption patterns already exceed the capacity of the earth. With 2.8 planets, the Swiss Ecological Footprint is nearly twice as high as the world average. For the new web calculator, it is assumed that the 20 million eco-points caused today per person (see presentation of Niels Jungbluth above) equal 2.8 planets. The calculator demonstrates that it is feasible to reduce one's footprint below the Swiss average. Reducing the footprint to one planet however requires considerable measures. According to the WWF footprint calculator, the actions needed are no motorised mobility, vegan nutrition, less than 25 m^2 net dwelling area per person and less than 300 CHF other consumption expenditures (clothing, restaurants, holidays, etc.) per month.

Hans Hertle (IFEU—Institut für Energie- und Umweltforschung, Heidelberg) presented the development of the German CO_2 calculator.[4] Governments, on the national as well as on different regional levels, have defined ambitious targets for greenhouse gas emission reductions. However, there was a variety of calculators providing very different results due to unequal system boundaries, scopes, emission factors, etc. Therefore, a consistent and scientifically based approach for a personal carbon footprint tool was needed and developed (Schächtele and Hertle 2007).

The resulting tool is based on German statistics and greenhouse gas emission factors. It includes the consumption areas private consumption, nutrition, mobility and private housing. Furthermore, public consumption is considered. The objective was to change the individual behaviour. This is not feasible overnight though. On a short-term view, the user behaviour and the short-term spending behaviour should be addressed. Sustainable mobility, holiday preferences and the personal diet are middle-term areas to be changed. On a long-term, decisions on buildings, place of living and on the energy quality consumed should be tackled. The tool allows for the comparison with the German average. A yearly update and the recording of the emissions over time are possible.

5 Short presentations

The focus of the short presentations of the day lay on the easy application of environmental assessment tools and on the comprehensible communication of LCA results. For the broad audience, it is important to communicate the LCA results in an understandable way in order to facilitate the consumers to change their behaviour in the right and most effective way.

Andreas Köhler (Delft University of Technology) presented the "LCA 2 go" project.[5] This project aims for the development of a tool that promotes the use of LCA in small and medium enterprises. It is argued that companies need to have a positive experience with the LCA approach so that they get interested in using LCA tools and in embedding them in their activities. The tool is based on simplified methods with technology relevant indicators. Sector-specific datasets and LCA approaches are developed. The public release of this open source web-based tool is planned to be in 2014.

Yves Loerincik (Quantis Intl. SA) identified four facts to consider when translating scientific results into environmental communication tools. First, it is important to base the communication on sound and reliable LCA results. Transparency is the second important point. Thirdly, it is necessary to keep the messages as simple, clear and precise as possible as most customers are not familiar with the LCA approach. Finally, he recommended applying a creative, new and unique approach for the communication. This draws the interest of the customers and the message sticks better.

Sébastien Humbert (Quantis Intl. SA) presented a web tool that provides an easy access to environmental information of coffee consumption.[6] LCA results are explained in an easy to understand and interactive manner. The tool enables the customer to discover the environmental impacts of the different life cycle stages. The customer can navigate through the tool following his interests. In that way, complex LCA results are presented in small and clearly arranged pieces of information.

6 Scientific contributions

In the last session of the day, scientific activities in the area of modelling of private consumption and rebound effects are presented.

Dominik Saner (ETH, Zurich) presented a multi-demand modelling approach, which allows for the assessment of the household consumption in Switzerland on an individual level (Saner et al. 2012). The model is based on the Federal Register of Buildings and Dwellings, the Household Budget Survey and the Multi-Agent Transport Simulation (MATSim). The resulting consumption patterns are then linked to LCA data.

[4] http://uba.klimaktiv-co2-rechner.de/de_DE/page/

[5] http://www.lca2go.eu/

[6] http://nescafe.outil-acv.com/

This allows for the analysis of the variability of household environmental impacts and their spatial distribution. Furthermore, the assessment of prospective scenarios of household consumption is feasible.

In a case study, the model is applied for the analysis of the households in Wattwil, a Swiss municipality. The analysis of the results shows that half of the households under study are responsible for only 21 % of the totally emitted greenhouse gases. Eighty percent of the households cause half of the emissions. This means that only 20 % of the households are responsible for half of the greenhouse gas emissions due to private consumption. The impacts of the households vary mainly in the area of mobility where 90 % of the household cause half of the emissions in the sector of mobility. The variability is less in the housing sector and least in the sector of nutrition. Compared to the Swiss average, the housing and mobility in Wattwil cause 10 % less greenhouse gas emissions; however, the impacts of the nutrition are clearly lower. It is concluded that the region of Wattwil should focus on households with high demand of motorised individual mobility if it intends to reduce the greenhouse gas emissions of the private consumption in the municipality.

Bastien Girod (ETH, Zurich) focused on rebound effects and their integration in LCA (Girod 2009). While in life cycle assessments, product improvements are directly transferred to the environmental impacts of the consumption of the product, the reality is often more complex. The improvements first affect the demand for the product under consideration and thus the consumption patterns. It is the combination of product improvement and shift in the demand that finally determine the environmental impacts of the product's consumption. This is illustrated on the example of mobility. The comparison of a car with an airplane shows that per person kilometre, the airplane is not only faster but also cheaper. Based on a consumption-as-usual scenario, the expenditures and travelling time remain the same independent of the mode of transportation. Consequently, more kilometres are travelled by plane than by car for the same amount of money or time. Even though the airplane emits less greenhouse gases per person-kilometre than a car, the final emission per journey are ultimately higher due to the higher mileage. From this example, it can be derived that higher costs for a good or service lead to no or negative rebound effects. Lower costs on the other hand stimulate rebound effects. The conclusion is that rebound effects should be considered when developing long-term scenarios. When aiming for sustainable consumption, it is important to shift to less greenhouse gas intensive consumption per time, service and monetary unit. One option is buying better and more expensive products.

7 Conclusions

From a methodological point of view, it became apparent that it is important to clearly define the system boundaries and the accounting method applied as the results and interpretation strongly depend on these assumptions. This is especially true when results are compared to sustainability targets such as the "2000-Watt Society" or other concepts.

Independent of the boundary conditions, however, two findings were confirmed in most of the presentations: The current consumption patterns in industrialised countries like Switzerland and Germany are clearly above a sustainable level and it needs rigorous changes to cut the environmental impacts of private consumption to a sustainable level. In private consumption, the three areas nutrition, mobility and energy use for housing were found to be the most important consumption areas. The reduction of animal products in the diet, less motorised mobility and energy efficient housing are identified as most effective but not yet sufficient measures for each area.

Ecological Footprint and Climate Footprint calculators are widespread and frequently used. They are an important tool for the awareness raising of private consumers, especially in combination with recommendations for reduction measures. Yet, there are only few calculators available that offer the saving of entries so that the development over time can be followed. The calculators are often static and future improvements in production and in the supply chain are not modelled. The public demand is a fix share. Changing consumption patterns alone is however not sufficient to cut environmental impacts to sustainable levels. Improvements in public consumption as well as in the service and production sector are also necessary.

An important challenge is to influence the small part of consumers that causes a large share of the environmental impacts, as they often are not as interested in information campaigns as consumers that already behave more environmentally friendly than the average. A further challenge is the consideration and avoidance of rebound effects that might be an issue if indirect effects of changes in lifestyles are not taken into account.

All presentations of the Discussion Forum are available for download at http://www.lcaforum.ch/Forum/tabid/57/Default.aspx.

Acknowledgments We thank the speakers for their interesting contributions to this Discussion Forum.

References

Bundesamt für Energie (2012) Energiestrategie 2050—Bericht des Teilprojekts Energienetze und Ausbaukosten, Bern

Frischknecht R, Steiner R, Jungbluth N (2009) The ecological scarcity methzd—eco-factors 2006: a method for impact assessment in LCA. Federal Office for the Environment FOEN, Zürich und Bern. www.bafu.admin.ch/publikationen/publikation/01031/index.html?lang=en

Girod B (2009) Integration of rebound effects into LCA—analysis of the environmental impact of product-consumption interactions. Swiss Federal Institute of Technology (ETH), Zurich

Jungbluth N, Nathani C, Stucki M, Leuenberger M (2011) Environmental impacts of Swiss consumption and production: a combination of input–output analysis with life cycle assessment. Environmental studies no. 1111. ESU-services Ltd. & Rütter + Partner, commissioned by the Swiss Federal Office for the Environment (FOEN), Bern, CH. www.esu-services.ch/projects/ioa/ or www.umwelt-schweiz.ch

Jungbluth N, Itten R, Schori S (2012) Environmental impacts of food consumption and its reduction potentials. In: Proceedings from the 8th International Conference on LCA in the Agri-Food Sector, Rennes, France, 2–4 October 2012

Kesselring and Winter (1994) Szenarienanalyse in Richtung einer 2000 W Gesellschaft CH

Palmedo PF, Nathans R, Beardsworth E, Hale SJ (1978) Energy needs, uses and resources in developing countries. Brookhaven National Laboratory, New York

Saner D, Jäggi B, Waraich R, Heeren N, Hellweg S (2012) Housing and mobility demands of individual households and their life cycle asssessment (in submission)

Schächtele K, Hertle H (2007) Die CO2 Bilanz des Bürgers. In: Berichte (ed. Umweltbundesamt). IFEU, Berlin. www.umweltbundesamt.de/uba-info-medien/dateien/3327.htm